Disruptive papers published in *Scientometrics*

(articles published between 2000 and 2010)

Lutz Bornmann* & Alexander Tekles*+

*Administrative Headquarters of the Max Planck Society

Division for Science and Innovation Studies

Hofgartenstr. 8,

80539 Munich, Germany.

Email: bornmann@gv.mpg.de; alexander.tekles.extern@gv.mpg.de

+Ludwig-Maximilians-University Munich

Department of Sociology

Konradstr. 6

80801 Munich, Germany.

Abstract

Wu, Wang, and Evans (2019) recently proposed a new, citation-based index of 'disruptiveness' that is based on a dynamic network measure of technological change. We present and discuss papers published in *Scientometrics* between 2000 and 2010 with the highest (positive) disruption index in this study.

Key words

bibliometrics, disruption index, citations

Since their introduction, citation analyses have simply counted the number of times papers have been cited in citation indexes such as Web of Science (WoS, Clarivate Analytics) or Scopus (Elsevier). Bu, Waltman, and Huang (2019) call this typical form of citation analysis one-dimensional impact measurement. However, a trend has recently appeared in bibliometrics that complements the one-dimensional with a multi-dimensional form. On the one hand, this trend refers to citation-context analyses, which can be undertaken more easily since data from PLOS, PubMed Central, Elsevier, and Microsoft Academic have been made available (Bertin, Atanassova, Sugimoto, & Lariviere, 2016). Citation context data are used to differentiate between cited papers, which are essential or peripheral for the citing authors (Bornmann & Daniel, 2008), or to explore the certainty of the knowledge that is reported in cited papers (Small, 2018). On the other hand, the multi-dimensional form of impact measurement refers to new indicators that use techniques such as co-citation analysis and bibliographic coupling to reveal the broadness and depth of impact (Bu et al., 2019).

Wu et al. (2019) recently proposed a new (multi-dimensional) citation-based index of ‘disruptiveness’ that is based on the dynamic network measure of technological change introduced by Funk and Owen-Smith (2017). Azoulay (2019) describes the index aptly and simple as follows: “when the papers that cite a given article also reference a substantial proportion of that article’s references, then the article can be seen as consolidating its scientific domain. When the converse is true – that is, when future citations to the article do not also acknowledge the article’s own intellectual forebears – the article can be seen as disrupting its domain”. Wu et al. (2019) present several statistical analyses (e.g. a comparison of the index with expert notions of disruption and development) that appear to prove that the disruption index does in fact measure what it intends to measure: new insights, ideas or methods that disrupt the cumulative nature in a scientific field.

Table 1. Thirty articles published in *Scientometrics* between 2000 and 2010 with the highest (positive) disruption index (papers from the top 1% with the highest disruption index in these publication years are printed in italics)

Disruption Index	First author	Publication year	Title	Volume	Issue	Page	Linked references	Citations
0.132939439	bordons, m	2002	Advantages and limitations in the use of impact factor measures for the assessment of research performance in a peripheral country	53	2	195	14	129
0.096885813	chiu, wt	2004	Bibliometric analysis of severe acute respiratory syndrome-related research in the beginning stage	61	1	69	10	31
0.068475452	weingart, p	2005	Impact of bibliometrics upon the science system: Inadvertent consequences?	62	1	117	17	174
0.05785124	von ungern-sternberg, s	2000	Bradford's law in the context of information provision	49	1	161	13	11
0.055137845	boshoff, nelius	2009	Neo-colonialism and research collaboration in Central Africa	81	2	413	10	30
0.049350649	van raan, afj	2005	Fatal attraction: Conceptual and methodological problems in the ranking of universities by bibliometric methods	62	1	133	19	280
0.042553191	archambault, eric	2006	Benchmarking scientific output in the social sciences and humanities: The limits of existing databases	68	3	329	15	136
0.040548599	glanzel, w	2006	Science in Brazil. Part 1: A macro-level comparative study	67	1	67	16	161
0.037433155	ren, sl	2002	International visibility of Chinese scientific journals	53	3	389	15	54
0.036437247	keiser, j	2005	Trends in the core literature on tropical medicine: A bibliometric analysis from 1952-2002	62	3	351	18	33
0.029739777	kademani, bs	2005	Nobel laureates: Their publication productivity, collaboration and authorship status	62	2	261	10	10
0.029100529	rinia, ej	2001	Citation delay in interdisciplinary knowledge exchange	51	1	293	10	41
0.027952481	tijssen, rjw	2002	Benchmarking international scientific excellence: Are highly cited research papers an appropriate frame of reference?	54	3	381	12	102
0.02739726	hsieh, wh	2004	Bibliometric analysis of patent ductus arteriosus treatments	60	2	205	10	44
0.026819923	lewison, g	2001	The quantity and quality of female researchers: A bibliometric study of Iceland	52	1	29	10	37
0.025396825	alfaraz, ph	2004	Bibliometric study on food science and technology: Scientific production in Iberian-American countries (1991-2000)	61	1	89	11	16
0.02490217	larsen, peder olesen	2010	The rate of growth in scientific publication and the decline in coverage provided by Science Citation Index	84	3	575	24	207

0.024444444	ho, ys	2003	Assessing stem cell research productivity	57	3	369	12	13
0.022026432	hudson, john	2007	Be known by the company you keep: Citations - quality or chance?	71	2	231	10	23
0.021699819	fernandez-cano, a	2004	Reconsidering Price's model of scientific growth: An overview	61	3	301	25	29
0.017797553	lariviere, vincent	2006	Canadian collaboration networks: A comparative analysis of the natural sciences, social sciences and the humanities	68	3	519	14	73
0.017595308	lariviere, vincent	2008	The declining scientific impact of theses: Implications for electronic thesis and dissertation repositories and graduate studies	74	1	109	15	12
0.016641452	laudel, g	2003	Study the brain drain: Can bibliometric methods help?	57	2	215	22	33
0.016064257	liu, chen-yuan	2010	Forecasting the development of the biped robot walking technique in Japan through S-curve model analysis	82	1	21	10	12
0.016	bornmann, lutz	2006	Selecting scientific excellence through committee peer review - A citation analysis of publications previously published to approval or rejection of post-doctoral research fellowship applicants	68	3	427	16	60
0.015541638	van eck, nees jan	2010	Software survey: VOSviewer, a computer program for bibliometric mapping	84	2	523	27	317
0.015421115	costas, rodrigo	2007	Variations in content and format of ISI databases in their different versions: The case of the Science Citation index in CD-ROM and the web of science	72	2	167	11	17
0.014440433	kim, mj	2001	A bibliometric analysis of physics publications in Korea, 1994-1998	50	3	503	17	12
0.014084507	ma, ruimin	2008	Scientific research competitiveness of world universities in computer science	76	2	245	10	18
0.014076577	gu, yn	2004	Global knowledge management research: A bibliometric analysis	61	2	171	27	35

Table 1 shows those papers published in *Scientometrics* that have the highest (positive) disruption index. The bibliometric data used are from an in-house database developed and maintained by the Max Planck Digital Library (MPDL, Munich) and derived from the Science Citation Index Expanded (SCI-E), Social Sciences Citation Index (SSCI), Arts and Humanities Citation Index (AHCI) prepared by Clarivate Analytics (Philadelphia, Pennsylvania, USA). We have only included papers from 2000 to 2010 to ensure a long citation window (from the date of publication up to 2017). Because the in-house database only includes publications published since 1980, and only linked cited references can be considered when calculating the disruption index, we focused on papers published in 2000 or later. To ensure a sufficient number of cited references and citations to calculate the disruption index, we only considered papers with at least 10 linked cited references and citations.

If we consider the disruption index values in Table 1, it is noticeable that most of the values are relatively small and close to zero. The paper by Bordons, Fernandez, and Gomez (2002) has the highest index value (at 0.13). The paper deals with the use of the popular Journal Impact Factor (JIF) in research evaluation. It focusses on the problematic use of the metric in the analysis of peripheral countries whose national journals are not covered in the Web of Science (WoS, Clarivate Analytics) database. The index value of the paper is much lower than the index value of the paper by Bak, Tang, and Wiesenfeld (1987), which has been mentioned by Wu et al. (2019) as a paper with an exceptionally high disruption index (0.86). However, the paper by Bak et al. (1987) was published in the 1980s, which may prove to be an advantage for receiving high disruption index values. In order to compare the disruption index values in Table 1 with reference values, we generated the index values for all papers (only papers with at least 10 linked cited references and citations) published between 2000 and 2010. The threshold for inclusion in the top 1% papers with the highest positive disruption index is 0.0268293. This means that the first 14 papers in Table 1 are among the top 1% disruptive papers in the publication years considered in this study.

The concentration of disruption values around zero in our set of *Scientometrics* papers as well as the percentiles of the comparison set indicate that a notable variance in the disruption index can only be found for a small proportion of papers. It would appear that the index is particularly suited to discriminate between papers at the extreme ends of its distribution. One factor that results in the high concentration around zero is that the index value is dominated by the cited side of the focal articles, more specifically the number of citing references of the focal paper's cited references. This implies that the citing behavior of an article's author has a great effect on its disruption index. The behavior of citing authors has to be considered when using this index to compare the disruptiveness of different papers. One possibility in this respect would be to field-normalize the index. Beyond that, a further examination of how the citation behavior of the focal paper's authors affects the disruptiveness values (e.g. the influence of the number of cited references) would allow a better interpretation of the index values.

References

Azoulay, P. (2019). Small research teams ‘disrupt’ science more radically than large ones. *Nature, 566*, 330-332.

Bak, P., Tang, C., & Wiesenfeld, K. (1987). Self-organized criticality: An explanation of the 1/f noise. *Physical Review Letters, 59*(4), 381-384. doi: 10.1103/PhysRevLett.59.381.

Bertin, M., Atanassova, I., Sugimoto, C. R., & Lariviere, V. (2016). The linguistic patterns and rhetorical structure of citation context: an approach using n-grams. *Scientometrics, 109*(3), 1417-1434. doi: 10.1007/s11192-016-2134-8.

Bordons, M., Fernandez, M. T., & Gomez, I. (2002). Advantages and limitations in the use of impact factor measures for the assessment of research performance in a peripheral country. *Scientometrics, 53*(2), 195-206. doi: Doi 10.1023/A:1014800407876.

Bornmann, L., & Daniel, H.-D. (2008). What do citation counts measure? A review of studies on citing behavior. *Journal of Documentation, 64*(1), 45-80. doi: 10.1108/00220410810844150.

Bu, Y., Waltman, L., & Huang, Y. (2019). A multidimensional perspective on the citation impact of scientific publications. Retrieved February 6, 2019, from https://arxiv.org/abs/1901.09663

Funk, R. J., & Owen-Smith, J. (2017). A Dynamic Network Measure of Technological Change. *Management Science, 63*(3), 791-817. doi: 10.1287/mnsc.2015.2366.

Small, H. (2018). Characterizing highly cited method and non-method papers using citation contexts: The role of uncertainty. *Journal of Informetrics, 12*(2), 461-480. doi: https://doi.org/10.1016/j.joi.2018.03.007.

Wu, L., Wang, D., & Evans, J. A. (2019). Large teams develop and small teams disrupt science and technology. *Nature, 566*, 378–382. doi: 10.1038/s41586-019-0941-9.